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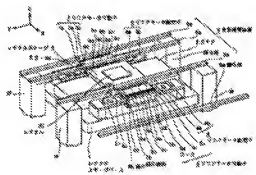
(71)Applicant : CANON INC
(72)Inventor : KORENAGA NOBUSHIGE

(54) CARRYING STAGE UNIT AND ALIGNER USING THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the transfer accuracy by providing a self wt. compensating means for canceling the wt. of a reticle stage, etc.
SOLUTION: A reticle stage 3 has a ceramic guide 2 to be scanned in a direction Y by a linear motor, composed of stators 4, 5 and movers 6, 7. At the tops of the movers 6, 7 attracting magnets 9a-9d are disposed and faced at a magnetic block 9e so as to exert a magnetic attractive force to cancel the wt. of the reticle stage 3, etc. The magnetic block 9e is supported with a support column 9f which is separate from the frame of an exposure apparatus which supports the guide, 2 and hence the center of gravity of the entire aligner will not shift, even if the stage moves, thus eliminating the transfer deviation due to the deformation of the frame.



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[Detailed Description of the Invention]
[0001]
[Field of the Invention]Especially this invention a reticle pattern in a semiconductor aligner circular or by

limiting to the strip region of rectangular shape, carrying out image formation to substrates (henceforth a

"substrate"), such as a wafer, and making reticle and a substrate scan synchronous, It is related with the

so-called moving stage device of the scanning exposure device which exposes the whole reticle pattern and is

transferred to a substrate, and the exposure device using this.
[0002]
[Description of the Prior Art]In what is called a scanning exposure device that makes the reticle and the substrate

which are the original edition scan synchronous, and transfers the whole reticle pattern to a substrate, The moving

stage device which is very highly precise, is stabilized and can control the scan speed of reticle or a substrate

is required, and it is common to the actuator of such a moving stage device to use a linear motor.
[0003]Drawing 7 shows the moving stage device by one conventional example, and this, The plate-like guide 102 fixed

on the reticle stage base 101, Along with the guide 102, the reticle stage 103 in which reciprocation moving is

free to Y shaft orientations (scanning direction), The linear motor stator 104,105 of the couple allocated in the

both sides in one with the reticle stage base 101 along the running route of the reticle stage 103, It has the

linear motor needle 106,107 of the both side surfaces of the reticle stage 103, and the couple provided

respectively in one, The linear motor stator 104,105 and the linear motor needle 106,107 constitute linear motor R1

of the couple which carries out the acceleration slowdown of the reticle stage 103 in a scanning direction,

respectively, and R2. The reticle stage 103 is shown by static pressure air bearing (air slide) E0 by non-contact

at the guide 102.
[0004]Each linear motor stator 104,105 is a linear motor stator of the polyphase coil change method which consists

of the six flat coils 104a and 105a allocated in the length direction of the guide 102, and the coil holders 104b

and 105b which support these.
The openings 106a and 107a of the linear motor needle 106,107 are penetrated.
If driving current is supplied one by one from the power supply which is not illustrated in the coils 104a and 105a

of the linear motor stator 104,105 and these are magnetized, the thrust of Y shaft orientations will occur in the

linear motor needle 104,105, and the reticle stage 103 will be accelerated or slowed down by this.
[0005]The reticle 110 adsorbs on the reticle stage 103, the wafer is held by the wafer stage 203 (refer to drawing

8) at the lower part, and the wafer stage 203 also has the same actuator as the reticle stage 103, and is

controlled similarly. According to the projection optical system 205 supported by the frame 204, image formation of

the band-like exposing light L0 (a dashed line shows a section to drawing 9) irradiated by a part of reticle 110 is

carried out to a wafer, it exposes the strip region, and transfers some reticle patterns. Each exposure cycle of a

scanning exposure device transfers the whole reticle pattern to a wafer by making it run the reticle stage 103 and

the wafer stage 203 synchronous to band-like exposing light L0.
During a run of the reticle stage 103 and the wafer stage 203, with the laser interferometer 108,208, the position

is detected, respectively and is fed back to an actuator.
Acceleration slowdown of the reticle stage 103 by linear motor R1 and R2 and speed control under exposure are

performed as follows.
[0006]When the reticle stage 103 is located at the graphic display left end of a scanning direction and center C0

of the width of the scanning direction of the reticle 110 is located in acceleration starting position P1 as shown

to drawing 9 in a top view for example, the acceleration by the thrust of graphic display facing the right of

linear motor R1 and R2 is started, When said center C0 of the reticle 110 reaches acceleration end position P2,

acceleration is stopped, and it serves for linear motor R1 and R2 to control the scan speed of the reticle stage

103 uniformly henceforth. When center C0 of the reticle 110 reached deceleration starting position P3, the slowdown

by the thrust of graphic display facing the left of linear motor R1 and R2 is started and center C0 of the reticle

110 reaches deceleration end position P4, a run of the reticle stage 103 is suspended.
[0007]In such an acceleration slowdown cycle, the reticle stage 103 runs rightward [graphic display], When

exposing light L0 enters into the graphic display right end of a reticle pattern, exposure is started and center C0

of the reticle 110 reaches deceleration starting position P3 at the same time center C0 of the reticle 110 reaches

acceleration end position P2, exposure of the whole surface of a reticle pattern is completed. The reticle stage

103 is controlled by the fixed scan speed during exposure of the reticle 110 (i.e., while a reticle pattern crosses

and runs exposing light L0), and the scan speed of the wafer stage 203 is similarly controlled synchronizing with

this. The wafer at the time of an exposure start and the relative position of the reticle 110 are managed strictly,

the wafer under exposure and the velocity ratio of the reticle 110 are controlled correctly in agreement with the

reducing magnification of the projection optical system 205 between both, and after exposure completion decelerates

both suitably.
[0008]The reticle stage base 101 is supported by the crowning of the frame 204 set up by the surface plate 201 of

the wafer stage 203 as shown in drawing 8, and the upper bed of the outer case 204a which is one.
The surface plate 201 is supported by floor line F0 via the vibration isolation 201a.

The light source which generates exposing light L0 is directly supported by floor line F0, as a dashed line shows.
[0009]
[Problem(s) to be Solved by the Invention]However, according to the above-mentioned conventional art, the reticle

stage base 101 is supported by the crowning of the frame 204 set up by the surface plate 201 of the wafer stage 203

as mentioned above, Since it is the composition which the reticle stage 103 is supported on the guide 102 on it,

and moves to Y shaft orientations, the whole centroid position changes substantially, generates distortion in frame

204 grade, and is made to transform this, when the reticle stage 103 moves in the crowning of an exposure device.
[0010]If frame 204 grade changes, the fall of the reliability of the detection value of the laser interferometer

108,208 which measures the position of a position gap of the projection optical system 205, the alignment optical

system which is not illustrated or the reticle stage 103, and the wafer stage 203 will be caused, and the transfer

accuracy of an exposure device will be worsened.
[0011]In addition to the static centroid movement by the scan of the reticle stage 103, when linear motor R1 and R2

drive, dynamic troubles, such as vibration resulting from the reaction force which each linear motor stator 104,105

receives, also have a possibility of influencing transfer accuracy like the above.
[0012]this invention -- the above -- it being made in view of unsolved SUBJECT which a Prior art has, and change of

the centroid position of the whole exposure device resulting from movement of moving stages, such as a reticle

stage, the dynamic trouble by the reaction force of driving force, etc., [avoid and] It aims at providing the

exposure device using the moving stage and this which can improve the transfer accuracy of an exposure device, etc.

substantially.
[0013]
[Means for Solving the Problem]In order to attain the above-mentioned purpose, a moving stage device of this

invention, In accordance with guide mechanism supported by the 1st support means, it has a freely movable moving

stage, a driving means to which this is moved, and a prudence compensation means which energizes said moving stage

upward, and this prudence compensation means is supported by the 1st support means and the 2nd support means that

is different bodies.
[0014]It is good to be characterized by providing a prudence compensation means with the 1st magnetic means

supported by the 2nd support means and the 2nd magnetic means held in a moving stage so that this might be

countered.
[0015]It is good to provide the 2nd magnetic means with an attraction magnet which adhered to a flexible region of

a driving means.
[0016]A holding part of a driving means may be supported by the 2nd support means.
[0017]
[Function]The weight (prudence) of a moving stage is offset by energizing upward the moving stage where it moves in

accordance with guide mechanism by a prudence compensation means. When it avoids that the weight of a moving stage

is applied to the frame of an exposure device, etc. through guide mechanism and a moving stage moves, it prevents

the centroid position of the whole exposure device changing.
[0018]The centroid position of the whole exposure device changes during exposure, and since there are no troubles,

such as causing the transfer gap by modification of a frame etc., the transfer accuracy of an exposure device is

substantially improvable.
[0019]If the holding part of the driving means is supported by the 2nd support means, it is avoidable for the

reaction force of the driving force of a driving means to spread to a projection optical system, an alignment

optical system, etc. of an exposure device, and to reduce transfer accuracy. By this, transfer accuracy can be

raised further.
[0020]

[Embodiment of the Invention] An embodiment of the invention is described based on Drawings.
[0021] Drawing 1 shows the moving stage device by one working example, and this, The plate-like guide 2 which is the

guide mechanism fixed on the reticle stage base 1 which is the 1st support means, The reticle stage 3 which is a

moving stage in which reciprocation moving is free to a scanning direction (Y shaft orientations) along with the

guide 2, The linear motor stators 4 and 5 of the couple allocated in the both sides in one with the reticle stage

base 1 along the running route of the reticle stage 3, Having the linear motor needles 6 and 7 of the both side

surfaces of the reticle stage 3, and the couple provided respectively in one, the linear motor stators 4 and 5 and

the linear motor needles 6 and 7 constitute the linear motor of the couple which is a driving means which carries

out the acceleration slowdown of the reticle stage 3 in a scanning direction, respectively. The reticle stage 3 is

shown by air slide (hydrostatic bearing device) E1 by non-contact at the guide 2.
[0022] The linear motor stators 4 and 5 which are the holding parts of each linear motor are polyphase coil change

type linear motor stators which consist of the six coils 4a and 5a allocated in series along with the guide 2, and

the coil stands 4b and 5b which support this.
The opening of the linear motor needles 6 and 7 which are the flexible regions of a linear motor, respectively is

penetrated.
If driving current is supplied one by one from the power supply which is not illustrated in the coils 4a and 5a and

these are magnetized, a thrust will occur among the linear motor needles 6 and 7, and the reticle stage 3 will be

accelerated or slowed down by this.
[0023] The reticle 30 adsorbs on the reticle stage 3, and as shown in drawing 2, the wafer W which is an exposure

body is held by the wafer stage 13 at the lower part.
The wafer stage 13 also has the same actuator as the reticle stage 3, and is controlled similarly.

Like a conventional example, according to the projection optical system 15, image formation of the band-like

exposing light irradiated by a part of reticle 30 is carried out to the wafer W it exposes the strip region, and

transfers some reticle patterns. The whole reticle pattern is transferred to the wafer W by making it run the

reticle stage 3 and the wafer stage 13 synchronous. In the meantime, with the laser interferometers 8 and 18, the

position of the reticle stage 3 and the wafer stage 13 is detected, respectively, and is fed back to each actuator.

The acceleration control under acceleration of the reticle stage 3 by said linear motor, a slowdown, and exposure

is the same as that of a conventional example.
[0024] The reticle stage base 1 is supported by the crowning of the frame 14 set up by the surface plate 11 of the

wafer stage 3, and the upper bed of the outer case 14a which is one. The surface plate 11 is supported by floor line F1 via the vibration isolation 11a.
The light source which generates the exposing light which is an exposure means is directly supported by floor line

F1, as a dashed line shows.
[0025] The laser interferometer 8 which detects the position of the scanning direction of the reticle stage 3 is

estranged to an X axial direction, and is formed one pair, and the mirror 8a of the couple for reflecting the laser

beam for Measurement Division in each laser interferometer 8 is allocated by the end of the reticle stage 3.
[0026] Next, the linear motor needles 6 and 7 and the reticle stage prudence compensating device 9 which is the

prudence compensation means which support the weight of the reticle stage 3 which are these and one are explained.

First, the yokes 6a and 7a which the linear motor needles 6 and 7 become from the griddle which counters ** of a

couple, It is a square cross section hollow body which consists of the magnets 6b and 7b for the drive of four

poles allocated by the opposed face of the inside, and the aluminum boards 6c and 7c of the couple which was

inserted into the both side surfaces of the yokes 6a and 7a, and was fixed to these.
The coil row of the linear motor stators 4 and 5 penetrates between the opposed faces of the magnets 6b and 7b of

the linear motor needles 6 and 7, respectively, is magnetizing each coils 4a and 5a one by one, and makes the

linear motor needles 6 and 7 generate a thrust as mentioned above.

[0027]The attraction magnets 9a-9d of a total of four rows which are the 2nd magnetic means that adhered to the

yokes 6a and 7a of the graphic display upper part [compensating device / 9 / reticle stage prudence] of each

linear motor needles 6 and 7, The magnetic body 9e of a total of four long pictures which are the 1st magnetic

means that countered the attraction magnets 9a-9d of each sequence, and was allocated, It has 9 f of a total of

four supports which are the 2nd support means that supports each magnetic body 9e, and 9 f of each struts are

independently set up by direct floor line F1 from the surface plate 11 of the wafer stage 13.
[0028]the attraction magnets 9a-9d of each sequence adjoin four pieces at a time, respectively -- it being

allocated and so that how [thing] may be carried out and a magnetic pole may become for reverse at **, A magnetic

circuit is formed through the yokes 6a and 7a of these, the magnetic body 9e, and the linear motor needles 6 and 7,

and the reticle stage 3 is energized upward by attracting each linear motor needles 6 and 7 to the magnetic body 9e

with the magnetic attraction power.
[0029]The ratio of the gap size between attraction magnets [of each sequence / 9a-9d] thickness, and the magnetic

body 9e which counters these by setting up appropriately. When offsetting the weight of the reticle stage 3 and the

linear motor needles 6 and 7 with said magnetic attraction power and the reticle stage 3 moves by the drive of a

linear motor, it can avoid that the centroid position of an exposure device changes like a conventional example.
[0030]Generally the bearing rigidity of air slide E1 established

between the guide 2 and the reticle stage 3, Since

figures triple [2-] are greatly set up compared with the ratio of change of said gap size to the magnetic

attraction power of the reticle stage prudence compensating device 9, Only the weight of reticle stage 3 grade is

offset with the reticle stage prudence compensating device 9, it can be stabilized in the magnetic attraction power

of the precompression unit of air slide E1, and it can be made to scan the reticle stage 3 in the state where it

does not influence.
[0031]This example is forming the reticle stage prudence compensating device which offsets the weight of the

reticle stage and linear motor needle which move on a guide in this way with magnetic attraction power, It prevents

the centroid position of an exposure device changing during the scan of a reticle stage, and the trouble of the

position of a projection optical system shifting according to modification of a frame etc., or a laser

interferometer or the reliability of the detection value of an alignment optical system which is not illustrated

falling during exposure, can be avoided. By this, the transfer accuracy of a scanning exposure device etc. is

substantially improvable especially.
[0032]Drawing 3 shows the moving stage device by the 2nd working example. This is changed to the polyphase coil

change type linear motor stators 4 and 5 of the 1st working example, and it is a thing using the what is called

single-phase-coils type linear motor stators 24 and 25, Each linear motor stators 24 and 25 have the top yokes 24c

and 25c which are the lower yokes 24a and 25a extended to a scanning direction along with the edges on both sides

of the guide 2, the coils 24b and 25b twisted around each lower yokes 24a and 25a, and the 1st magnetic means that

counters this.
[0033]The linear motor needles 26 and 27 have the magnets 26b and 27b the reticle stage 3, the magnet holders 26a

and 27a which are one, and for the drive held at the opening. The magnets 26b and 27b for a drive are fitted in the

gap formed between the coils 24b and 25b of the linear motor stators 24 and 25, and the top yokes 24c and 25c, and

are freely movable to a scanning direction, From the magnets 26b and 27b for the drive of the linear motor needles

26 and 27. The magnetic circuit which returns to the magnets 26b and 27b for a drive through the top yokes 24c and

25c of the linear motor stators 24 and 25 and the lower yokes 24a and 25a is formed, and the thrust of a scanning

direction occurs to the magnets 26b and 27b for a drive by magnetization of the coils 24b and 25b.
[0034]Since it is the same as that of the 1st working example about the reticle stage base 1, the guide 2, the

reticle stage 3, the laser interferometer 8, and 18 grades, it expresses with identical codes, and explanation is

omitted.
[0035]The reticle stage prudence compensating device 29 has the back yoke 29e which adhered to the attraction

magnets 29a-29d which are the 2nd held magnetic means as for a couple every, and attraction magnets [of each set /

29a-29d] back in the long groove of the couple of the magnet holders 26a and 27a of each linear motor needles 26

and 27. The top yokes 24c and 25c of attraction magnets [of each set / 29a-29d] one side to this, and the linear

motor stators 24 and 25 which counter, The magnetic circuit which returns to the attraction magnets 29a-29d of even

if it passes through the attraction magnets 29a-29d of another side and the back yoke 29e is constituted, and each

linear motor needles 26 and 27 are attracted by the top yokes 24c and 25c of the linear motor stators 24 and 25

with the magnetic attraction power by this.
[0036]The ratio of the gap size between attraction magnets [of each linear motor needles 26 and 27 / 29a-29d]

thickness, and the top yokes 24c and 25c of the linear motor stators 24 and 25 which counter these by setting up

appropriately. When offsetting the weight of the reticle stage 3 and the linear motor needles 26 and 27 with said

magnetic attraction power and the reticle stage 3 moves, it can avoid that the centroid position of an exposure

device changes like a conventional example.
[0037]The top yokes 24c and 25c of each linear motor stators 24 and 25 are combined with the lower yokes 24a and

25a in one in the both ends, and the both ends of the lower yokes 24a and 25a, It is supported by 29 f of supports

directly set up by floor line F2 which supports the surface plate 11 of the wafer stage 13 as shown in drawing 4.

That is, 29 f of supports support this from direct floor line F2 also about each linear motor stators 24 and 25

while supporting the weight of the reticle stage 3 or the linear motor needles 26 and 27 with attraction magnets [

29a-29d] magnetic attraction power. Therefore, the reaction force applied to each linear motor stators 24 and 25

when a linear motor is driven avoids effectively having an adverse effect on the projection optical system 14, an

alignment optical system or the laser interferometer 8, and 18 grades, and can improve the transfer accuracy of an

exposure device further.
[0038]Other points are the same as the 1st working example.
[0039]Next, working example of the manufacturing method of the semiconductor device using the exposure device which

explained [above-mentioned] is described. Drawing 5 shows the manufacturing flow of semiconductor devices

(semiconductor chips, such as IC and LSI, or a liquid crystal panel, CCD, etc.). The circuit design of a

semiconductor device is performed at Step 1 (circuit design). The mask in which the designed circuit pattern was

formed is manufactured at Step 2 (mask manufacture). At Step 3 (wafer manufacture), a wafer is manufactured using

materials, such as silicon. Step 4 (wafer process) is called a previous process, and forms a actual circuit on a

wafer with a lithography technology using the mask and wafer which prepared [above-mentioned]. Step 5 (assembly)

is called a post process, is a process semiconductor-chip-ized using the wafer produced by Step 4, and includes

processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At Step 6

(inspection), the operation confirming test of the semiconductor device produced at Step 5, an endurance test, etc.

are inspected. A semiconductor device is completed through such a process and this is shipped (Step S7).
[0040]Drawing 6 shows the detailed flow of the above-mentioned wafer process. The surface of a wafer is oxidized at

Step 11 (oxidation). An insulator layer is formed in a wafer surface at Step 12 (CVD). At Step 13 (electrode

formation), an electrode is formed by vacuum evaporation on a wafer. Ion is driven into a wafer at Step 14 (ion

implantation). A sensitizing agent is applied to a wafer at Step 15 (resist process). At Step 16 (exposure),

printing exposure of the circuit pattern of a mask is carried out at a wafer with the exposure device which

explained [above-mentioned]. The exposed wafer is developed at Step 17 (development). At Step 18 (etching),

portions other than the developed resist image are shaved off. The resist which etching could be managed with Step

19 (resist removing), and became unnecessary is removed. By carrying out by repeating these steps, a circuit

pattern is formed on a wafer multiplex. If the manufacturing method of this example is used, the semiconductor

device which is the degree of high integration for which manufacture was difficult can be manufactured

conventionally.
[0041]
[Effect of the Invention]Since this invention is constituted as above-mentioned, an effect which is indicated below

is done so.
[0042]Change of the centroid position of the exposure device resulting from movement of moving stages, such as a

reticle stage, the dynamic trouble by the reaction force of driving force, etc. are avoided, and the transfer

accuracy of an exposure device can be improved substantially.

[Claim(s)]
[Claim 1] In accordance with guide mechanism supported by the 1st support means, a freely movable moving stage, A

moving stage device which has a driving means to which this is moved, and a prudence compensation means which

energizes said moving stage upward and with which this prudence compensation means is characterized by being

supported by said 1st support means and the 2nd support means that is different bodies.
[Claim 2] The moving stage device according to claim 1, wherein a prudence compensation means is provided with the

1st magnetic means supported by the 2nd support means and the 2nd magnetic means held in a moving stage so that

this might be countered.
[Claim 3] The moving stage device according to claim 2, wherein the 2nd magnetic means is provided with an

attraction magnet which adhered to a flexible region of a driving means.
[Claim 4] A moving stage device given in Claims 1-3 any 1 paragraph, wherein a holding part of a driving means is

supported by the 2nd support means.
[Claim 5] An exposure device comprising:
A moving stage given in Claims 1-4 any 1 paragraph.
An exposure means which exposes an exposure body held at this.

[Translation done.]